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LEVELS-OF-GROWING-STOCK COOPERATIVE STUDY ON DOUGLAS-FIR

REPORT NO. 5

THE HOSKINS STUDY, 1963-1975

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
U.S. Department of Agriculture
Forest Service
Portland, Oregon

Levels-of-growing-stock study treatment schedule, showing percent of gross basal area increment of control plot to be retained in growing stock

Thinning	Treatment							
	1	2	3	4	5	6	7	8
	Percent							
First	10	10	30	30	50	50	70	70
Second	10	20	30	40	50	40	70	60
Third	10	30	30	50	50	30	70	50
Fourth	10	40	30	60	50	20	70	40
Fifth	10	50	30	70	50	10	70	30

Abstract for Report No. 1

Public and private agencies are cooperating in a study of eight thinning regimes in young Douglas-fir stands. Regimes differ in the amount of basal area allowed to accrue in growing stock at each successive thinning. All regimes start with a common level-of-growing-stock which is established by a conditioning thinning.

Thinning interval is controlled by height growth of crop trees, and a single type of thinning is prescribed.

Nine study areas, each involving three completely random replications of each thinning regime and an unthinned control, have been established in western Oregon and Washington, U.S.A., and Vancouver Island, Canada. Site quality of these areas varies from I through IV.

Climatic and soil characteristics for each area and data for the stand after the conditioning thinning are described briefly.

KEYWORDS: Thinnings, stand growth, Douglas-fir, *Pseudotsuga menziesii*.

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LEVELS-OF-GROWING-STOCK COOPERATIVE STUDY ON DOUGLAS-FIR

~~Report No.~~ 5 The Hoskins Study, 1963-1975

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Other LOGS (levels-of-growing-stock) reports:

WILLIAMSON, RICHARD L., and GEORGE R. STAEBLER.
1965. A cooperative level-of-growing-stock study in Douglas-fir. USDA For. Serv. Pac. Northwest For. and Range Exp. Stn., 12 p., illus. Portland, Oreg.
Describes purpose and scope of a cooperative study which is investigating the relative merits of eight different thinning regimes. Main features of six study areas installed since 1961 in young stands are also summarized.

WILLIAMSON, RICHARD L., and GEORGE R. STAEBLER.
1971. Levels-of-growing-stock cooperative study on Douglas-fir: Report No. 1--Description of study and existing study areas. USDA For. Serv. Res. Pap. PNW-111, 12 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.
Thinning regimes in young Douglas-fir stands are described. Some characteristics of individual study areas established by cooperating public and private agencies are discussed.

BELL, JOHN F., and ALAN B. BERG.
1972. Levels-of-growing-stock cooperative study on Douglas-fir: Report No. 2--The Hoskins study, 1963-1970. USDA For. Serv. Res. Pap. PNW-130, 19 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.
A calibration thinning and the first treatment thinning in a 20-year-old Douglas-fir stand at Hoskins, Oregon, are described. Data tabulated for the first 7 years of management show that growth changes in the thinned stands were greater than anticipated.

DIGGLE, P. K.
1972. The levels-of-growing-stock cooperative study in Douglas-fir in British Columbia (Report No. 3, Cooperative L.O.G.S. Study Series). Can. For. Serv. Inf. Rep. BC-X-66, 46 p., illus. Pac. For. Res. Cent., Victoria, B.C.

WILLIAMSON, RICHARD L.
1976. Levels-of-growing-stock cooperative study in Douglas-fir: Report No. 4--Rocky Brook, Stampede Creek, and Iron Creek. USDA For. Serv. Res. Pap. PNW-210, 39 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.
The U.S. Forest Service maintains three of nine installations in a regional, cooperative study of influences of levels of growing stock (LOGS) on stand growth. The effects of calibration thinnings are described for the three areas. Results of first treatment thinning are described for one area.

Reference Abstract

Berg, Alan B., and John F. Bell.
1979. Levels-of-Growing-Stock Cooperative Study on Douglas-fir: Report No. 5--The Hoskins Study, 1963-1975. USDA For. Serv. Res. Pap. PNW-257, 29 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Growth data are presented for the first 12 years of management of a young Douglas-fir stand in the Oregon Coast Ranges manipulated to include eight levels of growing stock. The second and third treatment periods are described, and summary data from the calibration and first treatment periods are given.

The study dramatically demonstrates the capability of young Douglas-fir stands to transfer the growth from many trees to few trees. It also indicates that at least some of the treatments have the potential to equal or surpass the gross cubic-foot volume of the controls during the next treatment periods.

KEYWORDS: Growing stock (-increment/yield, thinnings, Douglas-fir, *Pseudotsuga menziesii*.

RESEARCH SUMMARY

Research Paper PNW-257

1979

A regional cooperative study of the influence of levels of growing stock on stand growth was initiated in 1962. The School of Forestry, Oregon State University, maintains one of the nine study areas. The Hoskins study was established in 1963 in a 20-year-old Douglas-fir stand of natural origin and site class II.

Suppression mortality on the control plots has reduced the number of trees per acre from 1,727 in 1963 to 938 in 1975. There has been little mortality on thinned plots.

There was significantly more cubic-foot volume in trees of 11.6-inch diameter and larger for all treatments than for the control plots. All treatments except 1 and 2, the lowest levels of growing stock, had more cubic-foot volume in trees 9.6 inches and larger than the control plots did. In trees 7.6 inches and larger, however, cubic-foot volume for treatment 7--the highest level of growing stock--was approximately equal to the control plots; but all other treatments had less volume. Although the control plots have much more total cubic-foot volume, this additional volume is contained in the 639 trees (68 percent of the total) that are less than 7.6-inch d.b.h. In all probability, most of the mortality will occur in these size classes over the next few years. Also, the trees in thinned plots are growing at a much faster rate than the trees in control plots.

Treatments 7 and 8 have more board-foot volume than the controls, but the difference in board-foot volume between treatments 4, 5, and 6 and the controls is not great. Of special interest is treatment 4 which now has more board-foot volume in trees 11.6 inch d.b.h. and larger than the control plots have in trees 9.6 inches and larger. As the growing stock in treatment 4 increases with time, board-foot volumes could exceed those of the control and possibly of treatment 7.

The study dramatically demonstrates the capability of young Douglas-fir stands to transfer the growth from many trees to few trees. It also indicates that at least some of the treatments have the potential to equal or surpass the gross cubic-foot volume of the controls during subsequent treatment periods.

Contents

Tables

Figure 1.--Treatment 1, plot 8: *A*, 1963; *B*, 1966; *C*, 1976. Treatment 7, plot 19: *D*, 1963; *E*, 1966; *F*, 1976.

Introduction

This is one of a series of reports on a cooperative levels-of-growing-stock study on Douglas-fir in the Pacific Northwest designed to examine the effect of different levels of growing stock on wood production, tree size, and growth-growing stock ratios.

Report No. 1 presented the study plan, including analysis of data and description of installations. Report No. 2 covered the Hoskins study for the calibration period (1964-66) and the first treatment period (1967-70). This report covers the second (1971-73) and third (1974-75) treatment periods and includes summary data from the calibration and first treatment periods (see fig. 1 for pictorial comparison of plot 8 and plot 19 for 1963, 1966, and 1976).

The Hoskins study area is located approximately 22 miles west of Corvallis near Hoskins, Oregon, on land owned by Starker Forests. The area is immediately east of the summit of the Coast Ranges (fig. 2) on a southern aspect with slopes from 15 to 55 percent. At the time the study was established (1963), the stand was 14 years of age at breast height (total age, 20 years) and contained an average of 1,727 trees per acre (fig. 3). The study area is site II. The stand is of natural origin following wildfires.

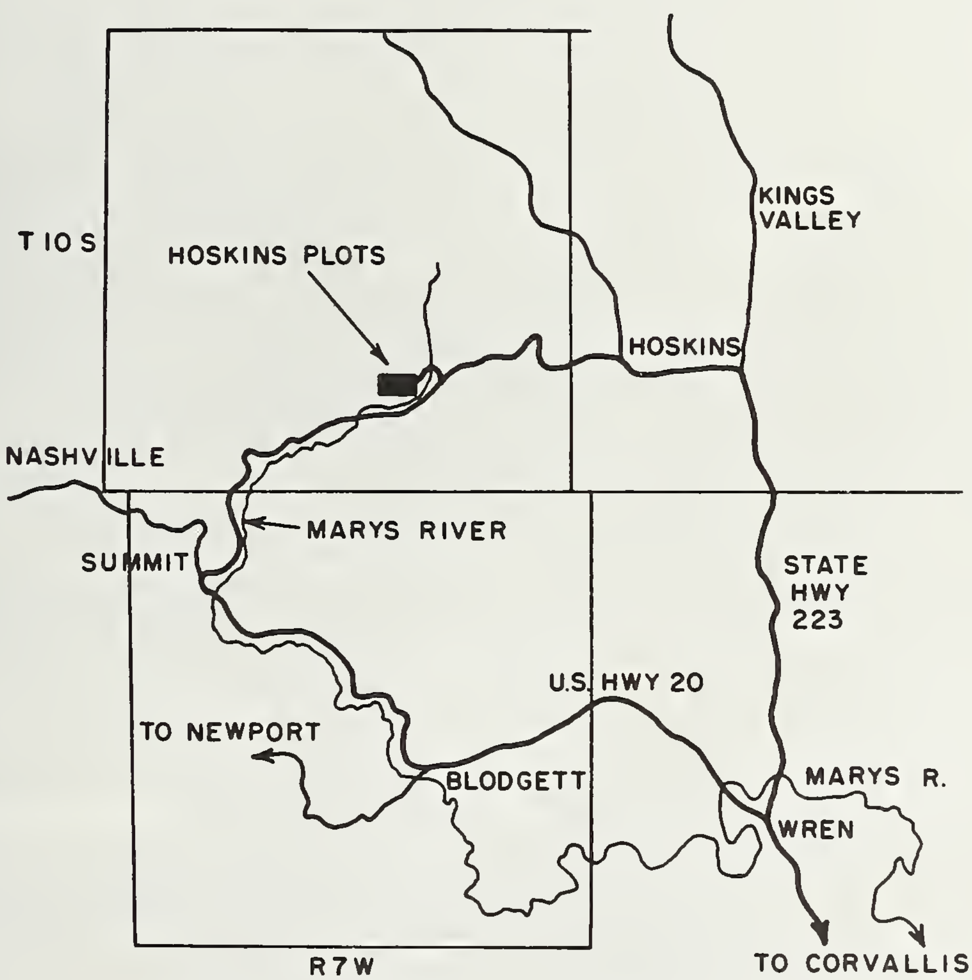

Figure 2.--Location of the Hoskins study.

Figure 3.--Plot 22 (control) in 1963. Crop trees have a white circumferential band painted at the point of measurement. Noncrop trees have a different color band for each treatment and identifying numbers of corresponding color. This facilitates work in the plots and identifies treatments for observers.

Methods[1]

During the summer of 1963, 27 plots, 1/5-acre in size, were established (fig. 4). Initial density was controlled by a calibration thinning to a prescribed level of basal area. The d.b.h. of each tree has been measured to the nearest 0.1 inch at the end of each growing season. Total height of selected trees was measured at the end of the 1963, 1966, 1970, 1973, and 1975 growing seasons (table 1). Thinnings were made when the height of the crop trees increased by 10 feet. Thus, thinnings were made when the height of the crop trees increased by 10, 20, 30, 40 feet, etc. Height growth (13.1 feet) during the first treatment period, however, exceeded this because the plots were not thinned for 4 years. This irregularity in relation of height growth to thinning interval was corrected in the third treatment period which reduced the period to two growing seasons (1974-75).

[1] The treatment schedule is found on the inside front cover. See Reports 1 and 2 for additional details. Other LOGS reports are listed on the back of the title page.

Results and Discussion

SECOND TREATMENT PERIOD

The second treatment period was three growing seasons (1971-73). The stand table at the beginning of the second treatment period is presented in table 9 and at the end of the period in table 11. Data for the trees removed during the second thinning are presented in table 10. Only one tree per acre per year died on treatments 2 and 5 compared with 62 trees per acre per year on the control plots (table 6).

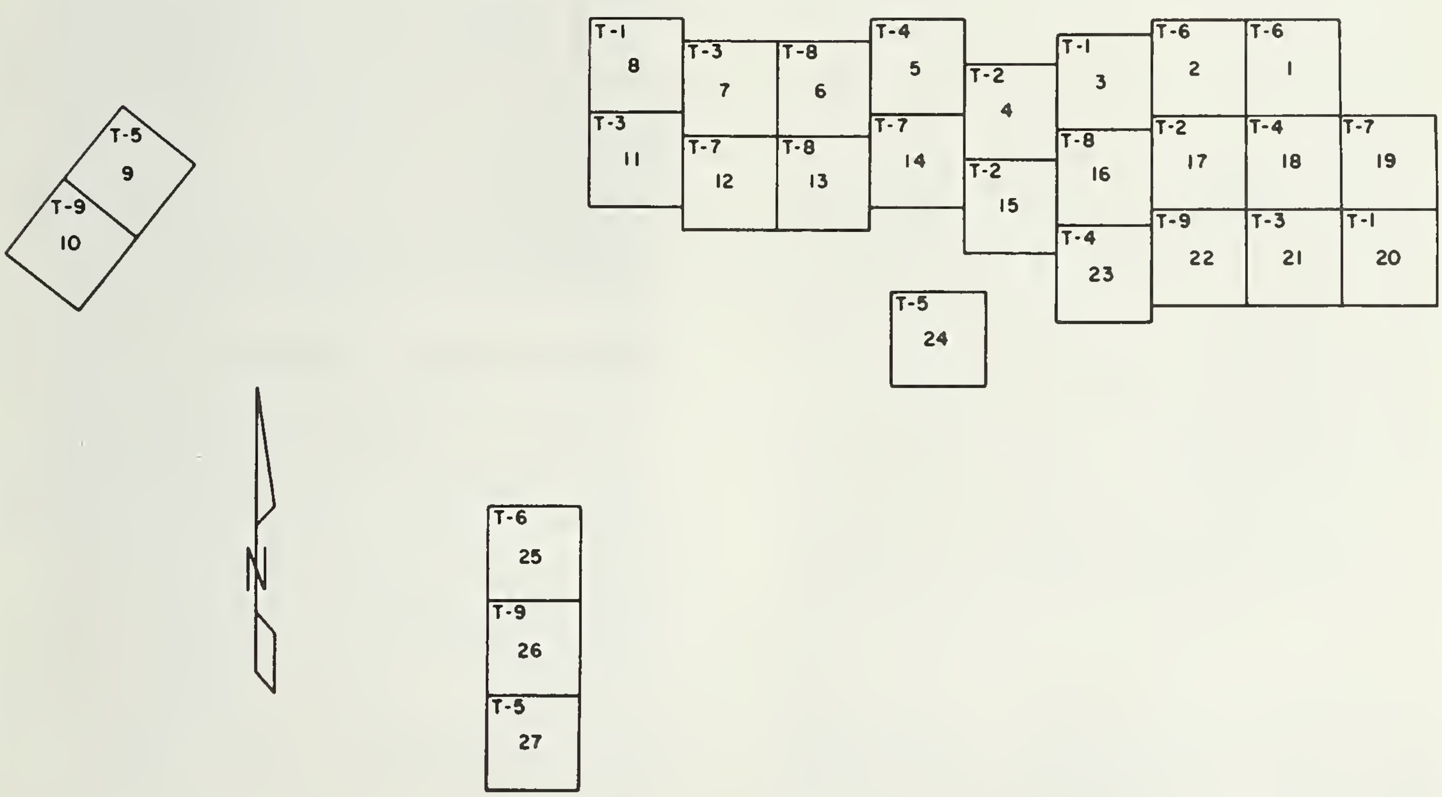

Figure 4.--Layout of Hoskins levels-of-growing-stock study. The plots are one-fifth acre in size.

All Live Trees

The basic data for all live trees (crop[2] and noncrop) for each treatment by growing season are shown in table 2. The table shows the wide range in basic data among the various treatments and the control. For instance, at the end of the second treatment period, the total number of trees per acre varied from 118 to 1,087 and the quadratic mean d.b.h. from 6.6 to 11.8 inches. Basal area per acre varied from 85.1 to 256.3 square feet and total volume per acre from 2,303 to 6,955 cubic feet.

The spread in quadratic mean diameter between treatments and control continues to widen. Most of this increase is due to growth because the quadratic mean diameter before and after each thinning are nearly the same.

Total volume in cubic feet varies according to stand density in either number of trees or basal area--the higher the density, the greater the volume.

The gross periodic annual increment[3] (PAI) and cumulative volume yield (see appendix 2 for calculation procedures) for all trees are given in table 4. The cumulative volume yield data do not include the volume removed during the calibration thinning. The volume removed, however, was estimated to be 1,238 cubic feet per acre--the difference between the average volume of the eight treatments and the control (table 2). The diameter PAI varied from 0.42 inch to 0.62 inch on treatment plots compared with 0.15 inch for the control plots. The basal area and cubic-foot volume increment among the eight treatments was largest for treatment 7 and smallest for treatment 1. The gross basal area increment of the control plots was greater than that of any of the treatments for the 1971 growing season. For the 1973 growing season, the gross basal area increment for treatment 7 was greater than that for the control plots; yet the total basal area per acre of the live trees was 148.7 and 247.4 square feet for treatment 7 and the control plots at the beginning of the 1973 growing season. The gross PAI for the second treatment period varied from 293 cubic feet per acre for treatment 1 to 583 cubic feet for the control plots. The basic stand data by treatment and plot for all live trees are shown in table 7.

Crop Trees

The stand data by treatment for the crop trees are given in table 3. At the end of the second treatment period (1973), the cubic-foot volume of the crop trees in the treatment plots was 1.6 to 1.9 times that of the crop trees in the control plots.

The crop tree increment data are shown in table 5. The basal area increment of the crop trees for the second treatment period for the thinned plots was 2.2 to 3.5 times greater than the basal area increment of the crop trees on the control plots. Of greater significance is that the PAI in cubic feet for the crop trees in the thinned plots is from 2.1 to 2.8 times that of crop trees in the controls.

The basic data for the crop trees by treatment and plot for the second treatment period are found in table 8.

THIRD TREATMENT PERIOD

The third treatment period was two growing seasons (1974-75) (see "Methods"). Data for the trees removed during the third treatment period are presented in table 10. The stand table at the beginning of the third treatment period is given in table 13 and at the end of the period in table 14. Only one tree per acre per year died on treatments 5, 7, and 8 compared with 74 trees per acre per year on the control plots (table 6).

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[2] An effort was made to designate well-formed, uniformly spaced, dominant trees at the rate of 80 per acre as crop trees prior to calibration thinning.

[3] Increment and growth are used synonymously in this report.

All Live Trees

The basic data for all live trees (crop and noncrop) during the third period for each treatment by year are given in table 2. At the end of the third treatment period, the total number of trees per acre varied from 83 to 938 and the average d.b.h. from 7.1 to 13.2 inches. Basal area per acre varied from 77.0 to 261.0 square feet and total volume per acre from 2,192 to 7,508 cubic feet. Treatment 1 has less basal area and cubic-foot volume at the end of the third treatment period than at the end of the second period because of the continued heavy thinnings called for in the study plan.

The spread in average diameter between treatments and the control continued to widen. Total volume in cubic feet varied according to stand density in either number of trees or basal area--the higher the density, the greater the volume.

The gross PAI and cumulative volume yield (see appendix 2 for calculation procedures) for all trees is given in table 4. The diameter PAI varied from 0.33 to 0.56 inch on treatment plots compared with 0.11 inch for the control plots. The basal area and cubic-foot volume increment among the eight treatments were largest for treatment 7 and smallest for treatment 1. Treatments 5, 6, 7, and 8 had a larger gross basal area PAI than the control plots (table 4). The gross basal area PAI per acre for treatment 7 for the third treatment period was 10.0 square feet compared with 8.8 for the control plots; yet the total basal area of the live trees was 150.0 and 256.3 square feet at the beginning of the 1974 growing season for treatment 7 and the control plots, respectively.

The gross PAI per acre for the third treatment period varied from 223 cubic feet for treatment 1 to 437 for treatment 7 compared with 440 cubic feet for the control plots.

Figure 5 gives the cumulative cubic-foot volume by treatments for 1975 for trees larger than 11.5, 9.5, 7.5, 5.5, and 3.5-inch d.b.h. Trees 12 inches and larger in the treatment plots had significantly more volume than trees in the control plots. Trees in all treatments except 1 and 2 had more cubic-foot volume in trees 10 inches and larger than did trees in the control plots. Volume of trees 8 inches and larger in treatment 7, however, was approximately equal to that of the control plots, but trees in all other treatments had less volume. Although the control plots have much more total cubic-foot volume, this additional volume is contained in the 639 trees (68 percent of the total) that are less than 7.6-inch d.b.h. (table 14). Most of the mortality will probably occur in these size classes over the next few years. Also, trees in the thinned plots are growing at a much faster rate than the trees in control plots. This could mean that the volumes in at least some of the thinned plots in the next treatment periods will equal or surpass those of the control plots.

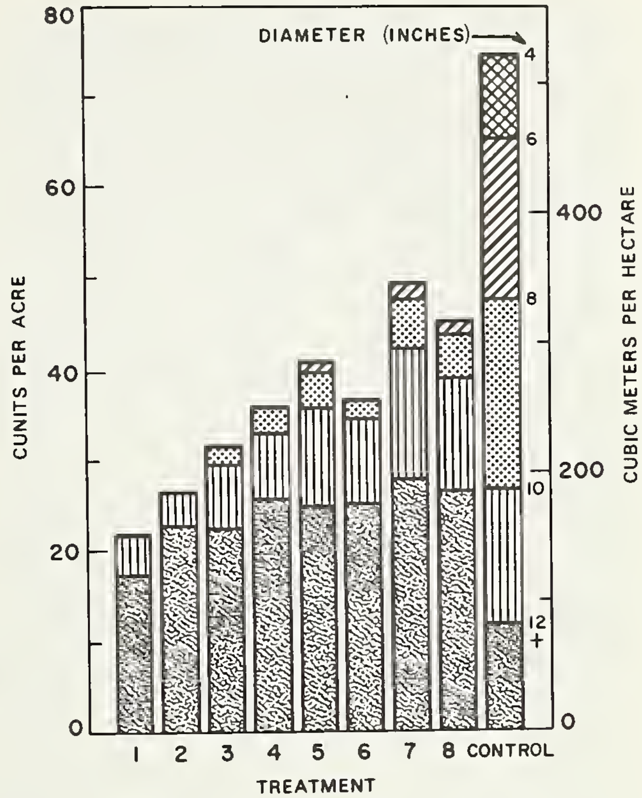

Figure 5.--Cumulative 1975 cubic-foot volumes for trees larger than 11.6-, 9.6-, 7.6-, 5.6-, and 3.6-inch d.b.h. by treatments; a cunit is 100 cubic feet.

Figure 6 shows the cumulative 1975 Scribner board-foot volumes for trees larger than 11.5-, 9.5-, and 7.5-inch d.b.h., all to a 6-inch top diameter. Only in treatments 7 and 8 did trees 7.6-inch d.b.h. and larger have more total board-foot volume than trees in the control plots. Trees 9.6-inch d.b.h. and larger, however, in all treatments except treatment 1 have more volume; and trees 11.6-inch d.b.h. and larger in all treatments have a larger board-foot volume than trees in the controls.

This further emphasizes the greater volume in the larger tree sizes in the treatment trees over those in the control plots. Trees in treatments 7 and 8 have more board-foot volume than trees in the controls, but the difference in volume between treatments 4, 5, and 6 and the controls is not great. Of special interest is treatment 4 which now has more board-foot volume in trees 11.6 inches and larger than the control plots have in trees 9.6 inches and larger. As the growing stock in treatment 4 increases with time, the board-foot volumes could exceed those of the control and possibly of treatment 7.

In figure 7 the Scribner board-foot volume thinned in 1966, 1970, and 1973 are added to the 1975 volumes in figure 6. With these additional volumes, only treatments 1 and 2 have less total board-foot volume than the control plots.

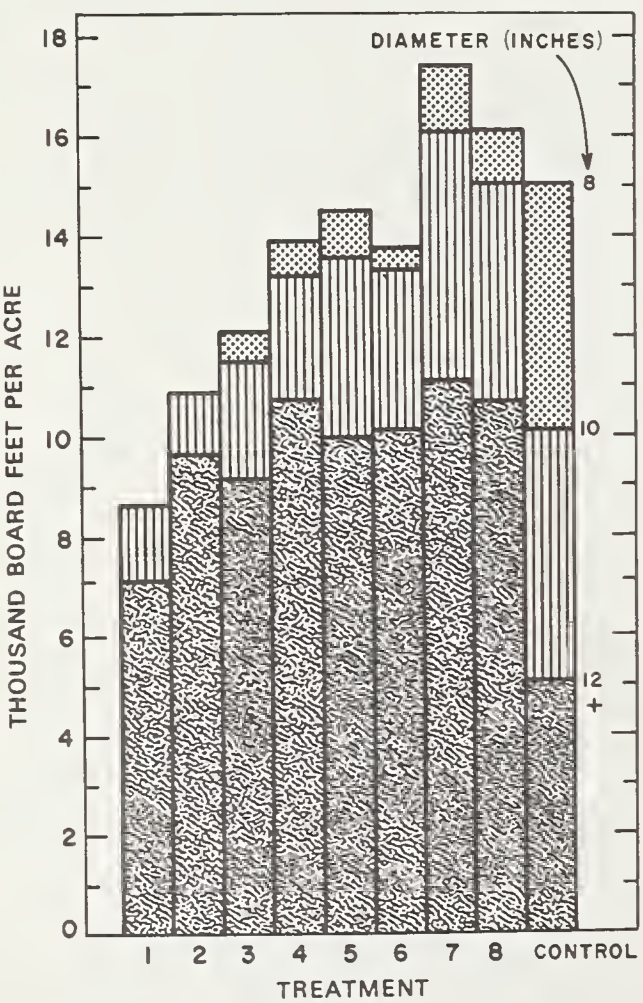

Figure 6.--Cumulative 1975 Scribner board-foot volumes for trees larger than 11.5-, 9.5-, and 7.5-inch d.b.h. to a 6-inch-top diameter by treatments.

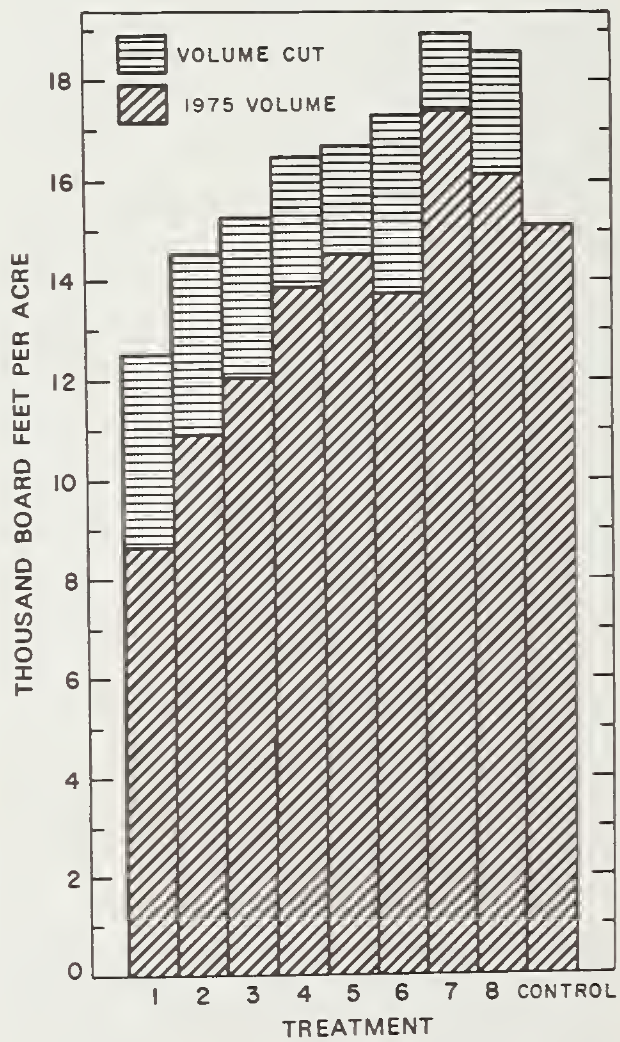

Figure 7.--Scribner board-foot volumes in 1975 and total volumes thinned in 1966, 1970, and 1973 by treatments for trees 7.6-inch d.b.h. and larger to a 6-inch-top diameter, based on 16-foot logs.

Crop Trees

The stand data by treatment for the crop trees are given in table 3. At the end of the third treatment period, the cubic-foot volume of the crop trees in the treatment plots was 1.7 to 2.1 times that of the trees in the control plots. The gross PAI data for crop trees are shown in table 5. The basal area PAI of the crop trees for the third treatment period for the thinned plots was 2.7 to 4.6 times greater than the basal area PAI of the crop trees on the control plots. The basic data for the crop trees by treatment and plot for the third treatment are found in table 8. The gross cubic-foot PAI for the crop trees in the thinned plots are from 2.2 to 3.6 times that of crop trees in the control plots. These data show that the growth rates of the crop trees in the thinned plots are increasing with time relative to those of the crop trees in the control plots (see discussion under "Crop Trees" for the second treatment period).

Discussion, All Treatment Periods, 1963-75

Data for All Live Trees

Natural suppression mortality reduced the number of trees on the control plots by 46 percent (1,727 to 938 per acre). Mortality on the thinned plots was minimal (table 6). After the calibration thinning in 1963, the number of trees per acre in the thinned plots varied from 328 to 365. As a result of three treatment thinnings, the number of trees per acre in 1975 varied from 83 to 260 (table 2). The average d.b.h. for all trees on the thinned plots at the end of the 1963 growing season was just over 5.0 inches. By the end of the 1975 growing season, the average d.b.h. of trees on the thinned plots varied from 10.9 to 13.2 inches. In contrast, the average d.b.h. of trees on the control plots was 3.8 inches in 1963 and 7.1 inches in 1975.

Basal area per acre for the thinned plots varied only from 49.0 to 50.4 square feet at the beginning of the calibration period (1963). By the end of the 1975 growing season, the basal area per acre for the thinned plots ranged from 77.0 to 169.8 square feet because of treatment differences. The basal area per acre of the control plots increased from 138.1 square feet in 1963 to 261.0 square feet in 1975. The cubic-foot volume per acre for the thinned plots varied from 720 to 768 in 1963 and from 2,192 to 4,959 in 1975. The control plots contained 1,982 cubic feet per acre in 1963 and 7,508 in 1975 (table 2).

Table 12 presents net PAI per acre for the average diameter, basal area, and cubic volumes for all trees. The basal area PAI for the thinned plots during the calibration period varied from 11.8 to 12.7 square feet; for the control plots, it was 15.5 square feet. For the first treatment period, the basal area PAI varied from 11.1 to 13.6 square feet, and the control plots averaged 11.0 square feet. For the second treatment period, the basal area PAI varied from 8.2 to 12.4 square feet for the thinned plots and averaged 9.2 square feet for the control plots. For the third treatment period, the basal area PAI of the thinned plots varied from 6.3 to 9.9 square feet, and that of the control plots averaged 2.3 square feet. From 1963 through 1975, treatments 5, 6, 7, and 8 each had a larger basal area increment than the control plot (table 12). Table 4 shows that the basal area PAI for all plots was considerably lower for the 1972 growing season which accounts for some of the difference between the PAI for the first treatment period and the second treatment period for treatment 7.

A comparison of the change in cubic-foot PAI for the treatments and for the control plots shows that the change in cubic-foot PAI for treaments 3 through 8 was greater than that for the control plots for both the first and second treatment periods. For example, PAI for treatment 7 was 275, 428, and 496 for the calibration, first treatment, and second treatment periods, respectively; the corresponding PAI for the

control plots was 460, 512, and 515 (table 12). Thus, treatment 7 PAI increased 153 cubic feet between the calibration period and the first treatment period and 68 cubic feet between the first treatment period and the second treatment period, compared with 52 and 3 cubic feet for the control plots.

For the third treatment period, the cubic-foot PAI for treatments 1 and 2 was less than the cubic-foot PAI for treatments 1 and 2 for all previous periods (table 12). The cubic-foot PAI for all treatments for the third treatment period was below that for the second treatment period. Only treatment 1, the lowest level of growing stock, had a lower PAI than the control plots. The large reduction in the PAI for the control plots is attributed to the mortality that occured in 1974. A comparison of the PAI between treatments 1 and 2 and between treatments 3 and 4 for the second and third treatment periods shows that the increased level of growing stock in treatments 2 and 4 has produced an increased PAI. A comparison of the PAI between treatments 5 and 6 and between treatments 7 and 8 for the second and third treatment periods shows that the decreased level of growing stock in treatments 6 and 8 has produced a decreased PAI.

There was no ingrowth in any of the plots from 1964 through 1975.

Data for All Live and Dead (Mortality) Trees

The cumulative gross basal area yield for all trees by treatment and thinning period is shown in figure 8. The amount of material removed by the calibration thinning was derived from the control plot data since records were not kept of the actual amount removed during the calibration thinning.

Figure 9 shows the gross cubic-foot yield by treatment and thinning period. Note the uniformity of initial volume even though the initial level of growing stock was determined by basal area. There were only minor fluctuations in cubic-foot volume increment during the calibration period. Growth during the

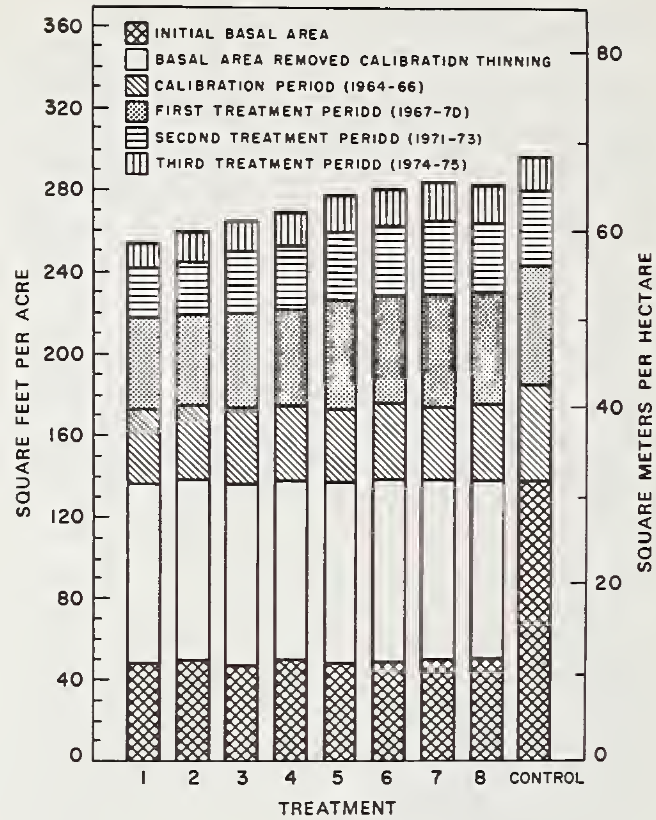

Figure 8.--Cumulative gross basal area yield by treatment and thinning period.

first and second treatment periods is directly correlated with the level of growing stock in each treatment period (tables 2 and 4). In the third treatment period, however, treatment 7 with a beginning volume of 4,092 cubic feet had a cubic-foot PAI of 437 compared with a beginning volume of 6,955 cubic feet and a cubic-foot PAI of 440 for the control plots. Treatment 7 had the greatest total cubic-foot yield of any treatment. Figures 10 and 11 show the gross periodic annual increment by treatment and thinning period. Figure 10 illustrates the relationship of the gross PAI by period within each treatment. Treatments 5, 6, 7, and 8 each had a greater difference in gross cubic-foot PAI between the calibration period and the first treatment period than did the control plots. This was also true between the first treatment period and the second treatment period. For example, the gross PAI for treatment 7 was 275 cubic feet for the calibration period and 428 cubic feet for the first treat-

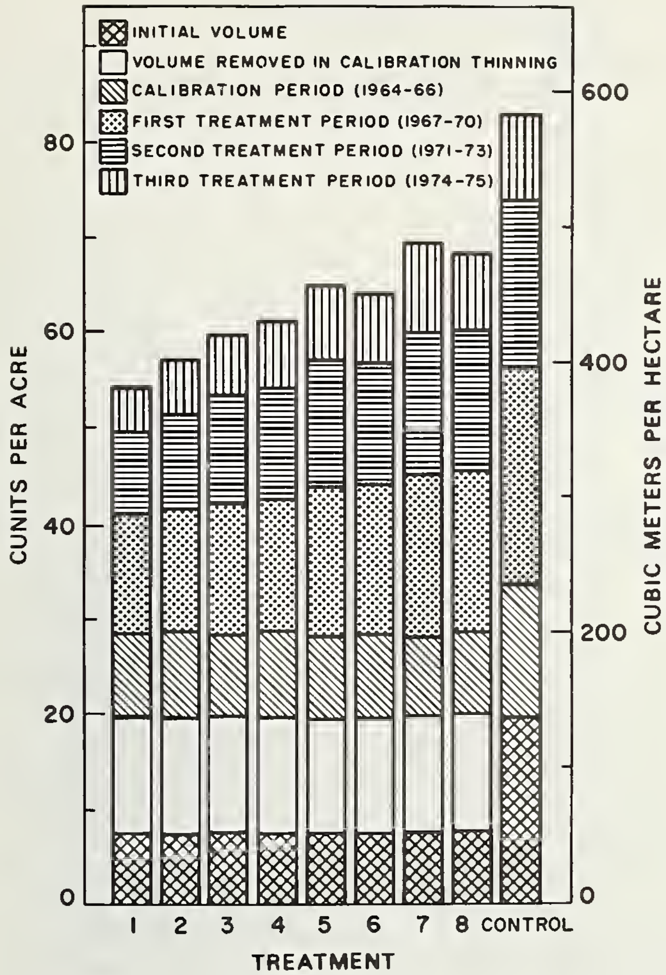

Figure 9.--Gross cubic-foot yield by treatment and thinning period; a cunit is 100 cubic feet.

ment period, a difference of 153 cubic feet. The gross PAI difference for the control plots between the calibration period and the first treatment period was 104 cubic feet. The difference between the first treatment period and the second treatment period in gross PAI for treatment 7 was 63 cubic feet compared with 10 cubic feet for the control plots. For the third treatment period, the gross cubic-foot PAI increment for each treatment and for the control was less than it had been during the second treatment period.

Although the gross basal area PAI decreased for each treatment period for the control plots (16.2, 14.2, 12.3, and 8.8 for the calibration through third treatment periods), the gross cubic-foot PAI increased for the control plots for each period except the third treatment period (469, 573, 583, and 440 for the calibration through third treatment periods)(table 4).

Figure 11 illustrates the relationship of the gross PAI by treatment within each period. Significant changes have occurred in the comparative growth rates of the control and the treatments.

The treatments during the calibration period had similar rates of growth because they had nearly equal levels of growing stock; however, growth was much lower than that for the controls because the levels of growing stock in the treatments were severely reduced.

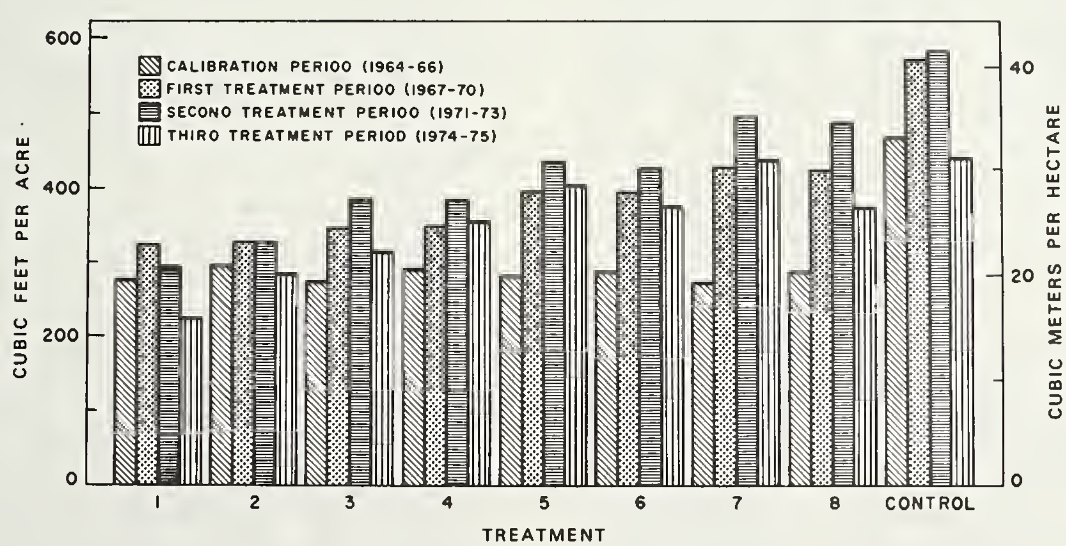

Figure 10.--Gross periodic annual increment by treatment and thinning period.

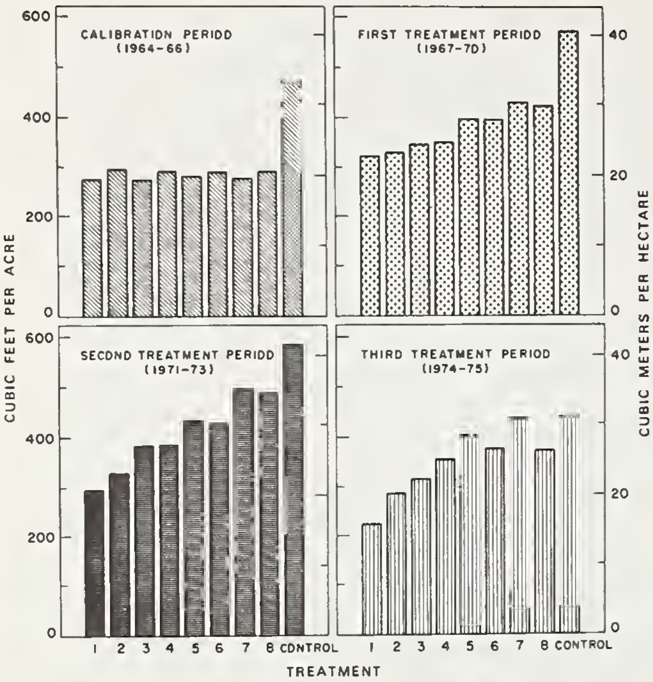

Figure 11.--Gross periodic annual increment by treatment for each treatment period.

During the first and second treatment periods, growth increased with the level of growing stock. In the first treatment period, there were, in effect, only four treatments, since treatments 1 and 2 were the same, as were 3 and 4, 5 and 6, and 7 and 8. Thus, the PAI was uniform within each pair of treatments but increased with an increased level of growing stock. The PAI differential among treatments continued to be more marked during the second treatment period. For the third treatment period, figure 11 shows the effect of increasing the level of growing stock for treatments 2 and 4 and decreasing the level of growing stock for treatments 6 and 8. It also shows that the difference in growth was much less between treatments 5 and 7 and the control.

The differences in PAI between treatments 3, 4, 5, 6, 7, and 8 and the control became smaller with each succeeding treatment period. In contrast, treatment 1 shows a larger difference in PAI compared with the control. Treatment 2 did show a slightly smaller difference in PAI compared with the control during the third treatment period. Treatment 7

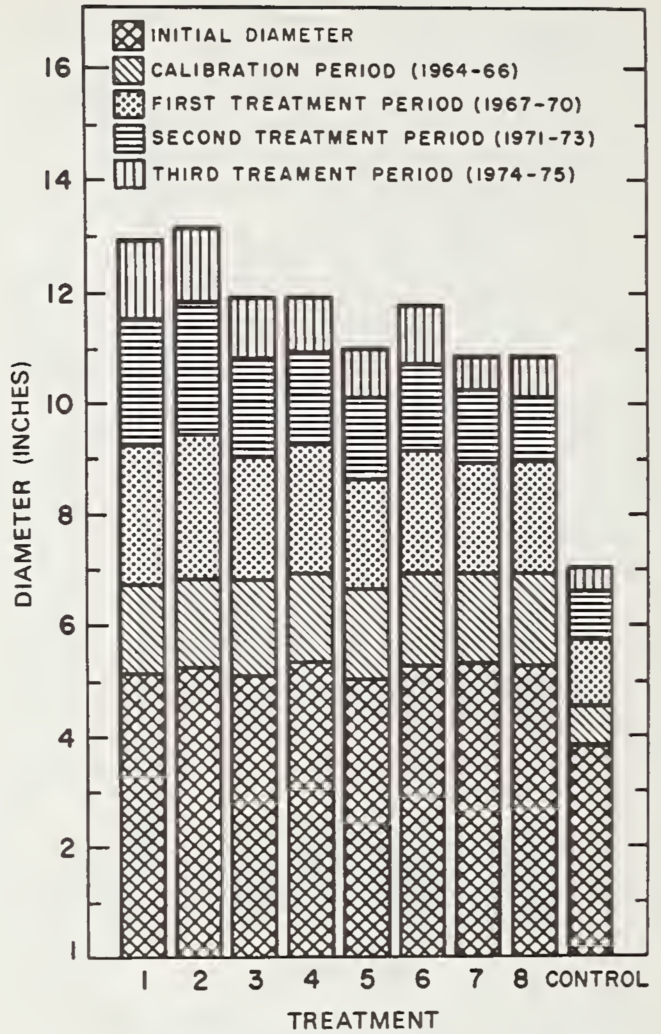

Figure 12.--Quadratic mean diameter growth by treatment and thinning period.

had the largest gross cubic-foot PAI of all the treatments for each treatment period.

Figure 12 gives the quadratic mean diameter growth by treatment and thinning period. Treatments 1 and 2 had the largest quadratic mean diameters, and the control plots the lowest.

At this point, the study dramatically demonstrates the capability of young Douglas-fir stands to transfer the growth from many trees to few trees. It also indicates that trees in at least some of the treatments have the potential to equal or surpass the gross cubic-foot volume of trees in the controls during the next treatment periods.

Appendix 1

DESCRIPTION OF EXPERIMENT (as excerpted from Report No. 1)

The experiment is designed to test a number of thinning regimes beginning in young stands made alike at the start through a "calibration" thinning. Thereafter, through the time required for 60 feet of height growth, growing stock is controlled by allowing a specified addition to the growing stock between successive thinnings. Any extra growth is cut and is one of the measured effects of the thinning regime.

EXPERIMENTAL DESIGN

A single experiment consists of eight thinning regimes plus unthinned plots whose growth is the basis for treatment in these regimes. There are three plots per treatment, arranged in a completely randomized design for a total of twenty-seven 1/5-acre plots.

Interaction of site quality and treatment can be evaluated by replicating installations on each site quality class. Cooperative effort has made this replication possible.

CROP TREE SELECTION

Well-formed, uniformly spaced, dominant trees at the rate of 80 per acre, or 16 per plot, are designated as crop trees before initial thinning. Each quarter of a plot must have no fewer than three suitable crop trees nor more than five--another criterion for stand uniformity.

INITIAL OR "CALIBRATION" THINNING

All 24 treated plots are thinned initially to the same density to minimize the effect of variations in original density on stand growth. Density of residual trees is controlled by quadratic mean diameter (diameter of tree of average basal area) of the residual stand according to the formula:

$$\text{Average spacing in feet} = 0.6167\ (\text{quadratic mean d.b.h}) + 8.$$

If one concentrates on leaving a certain amount of basal area corresponding to an estimated overall quadratic mean d.b.h. ($\bar{D}q$), then the residual number of trees may vary freely and the actual $\bar{D}q$'s may vary ± 10 percent between plots. Alternatively, if emphasis is on leaving a certain number of trees corresponding to an estimated overall $\bar{D}q$, then the basal area may vary and the actual $\bar{D}q$'s may vary ± 15 percent between plots.

TREATMENTS

The eight thinning regimes differ in the amount of basal area allowed to accumulate in the growing stock. The amount of growth retained at any thinning is a predetermined percentage of the gross increase found in the unthinned plots since the last thinning (see the table on the inside front cover). The average residual basal area for all thinned plots after the calibration thinning is the foundation upon which all future growing stock accumulation is based. As used in the study, the three control plots may be thought of as providing a "local gross yield table" for the study area.

For example, the following procedure was used to determine the level of growing stock for each treatment for the beginning of the third treatment period. The average gross square-foot basal area increment per acre of the control plots equals net basal area increment plus mortality.

Net basal area increment per acre	27.67
Basal area of mortality per acre	9.32
Gross basal area increment per acre	36.99

The calculated basal area level in square feet per acre by treatment at the beginning of the third treatment period is:

Treatment No.	Percent basal area to be retained[1]	Basal area at beginning of second treatment period	+	Gross basal area increment	=	Basal area at beginning of third treatment period
1	10	60.4		[2] 3.70		[2] 64.1
2	30	66.2		11.10		77.3
3	30	81.6		11.10		92.7
4	50	87.0		18.50		105.5
5	50	103.6		18.50		122.1
6	30	97.8		11.10		108.9
7	70	124.5		25.89		150.3
8	50	118.7		18.50		137.2

CONTROL OF THINNING INTERVAL

Thinnings will be made after the calibration thinning whenever average height growth of crop trees comes closest to each multiple of 10 feet.

CONTROL OF TYPE OF THINNING

As far as possible, type of thinning is eliminated as a variable in the treatment thinnings through several specifications:

1. No crop tree may be cut until all noncrop trees have been cut (another tree may be substituted for a crop tree damaged by logging or killed by natural agents).
2. The quadratic mean diameter of cut trees should approximate that of trees available for cutting.
3. The diameters of cut trees should be distributed across the full diameter range of trees available for cutting.

[1] See the treatment schedule on the inside front cover.

[2] Example calculation:
10 percent of 36.99 = 3.70; 60.4 + 3.70 = 64.1.

Appendix 2

CALCULATING CUMULATIVE YIELD, TABLES 4 AND 5[1]

Example: treatment 1

	Cubic feet[2]
Volume at end of 1963 growing season, table 2	744
Net increment, 1964-66 (1,579-744 cubic feet), table 2	835
Mortality, 1964-66, table 6 (3 x 0.6)	2
	1,581
Net increment, 1966-70 (2,314-1,027 cubic feet), table 2	1,287
Mortality, 1966-70	0
1,581 + 1,287 =	2,868
Net increment, 1970-73 (2,303-1,423 cubic feet), table 2	880
Mortality, 1970-73	0
2,868 + 880 =	3,748
Net increment, 1973-75 (2,192-1,745 cubic feet), table 2	447
Mortality, 1973-75	0
3,748 + 447 =	4,195

[1] Does not include the material removed during the calibration thinning.

[2] Inside bark.

Table 1--Average height of crop trees by treatment and year

Treatment number	Average height[1/] (feet)				
	1963	1966	1970	1973	1975[2/]
1	35.9	46.0	58.7	68.5	73.7
2	35.1	46.0	59.5	70.1	76.9
3	36.1	45.8	58.7	69.8	75.7
4	36.8	47.3	60.2	70.2	77.5
5	35.7	46.6	59.6	69.5	75.4
6	36.7	46.0	59.1	68.8	74.8
7	35.9	45.6	59.2	69.4	75.8
8	36.3	46.2	59.7	70.0	75.0
Control	36.5	45.9	58.6	67.0	78.2

[1/] Differences in average height between this report and Report No. 2 are due to several changes in crop trees.

[2/] Heights of trees 10-inch d.b.h. and larger were used because some of the measured crop trees are now part of the understory.

Table 2--Stand data for all live trees in English units, at beginning and end of periods, by treatment

Number of trees per acre[1]

Treatment numbers	Calibration		1st treatment period		2d treatment period				3d treatment period		
	1963	1966	1966[2]	1970	1970[3]	1971	1972	1973	1973[4]	1974	1975
1	353	352	215	215	118	118	118	118	83	83	83
2	343	342	207	207	125	125	125	123	97	97	97
3	343	342	252	252	175	175	175	175	140	140	140
4	333	330	243	243	180	180	180	180	160	160	160
5	365	363	312	312	250	248	248	248	213	213	212
6	338	338	283	283	210	210	210	210	168	168	168
7	328	328	323	323	287	287	287	287	262	260	260
8	337	335	327	327	275	275	275	275	242	240	240
Control	1,727	1,640	1,640	1,272	1,272	1,203	1,145	1,087	1,087	968	938

Quadratic mean diameter at breast height[5] (inches)

Treatment numbers	Calibration		1st treatment period		2d treatment period				3d treatment period		
	1963	1966	1966[2]	1970	1970[3]	1971	1972	1973	1973[4]	1974	1975
1	5.1	6.7	6.9	9.2	9.7	10.3	10.9	11.5	11.9	12.5	13.0
2	5.2	6.8	7.0	9.4	9.9	10.5	11.1	11.8	12.0	12.6	13.2
3	5.1	6.8	6.8	9.0	9.3	9.8	10.3	10.8	11.0	11.5	11.9
4	5.3	6.9	7.0	9.2	9.4	10.0	10.5	10.9	11.0	11.4	11.9
5	5.0	6.6	6.6	8.6	8.7	9.2	9.6	10.1	10.2	10.6	11.0
6	5.2	6.9	7.0	9.1	9.2	9.8	10.3	10.7	10.9	11.3	11.8
7	5.3	6.9	6.9	8.9	8.9	9.4	9.8	10.2	10.3	10.6	10.9
8	5.2	6.9	6.9	8.8	8.9	9.4	9.8	10.1	10.2	10.6	10.9
Control	3.8	4.5	4.5	5.7	5.7	6.0	6.3	6.6	6.6	7.0	7.1

Basal area per acre (square feet)

Treatment numbers	Calibration		1st treatment period		2d treatment period				3d treatment period		
	1963	1966	1966[2]	1970	1970[3]	1971	1972	1973	1973[4]	1974	1975
1	49.4	85.5	55.1	99.5	60.4	68.9	76.2	85.1	64.4	70.6	77.0
2	50.0	87.1	55.9	100.5	66.2	75.5	84.3	93.3	76.5	83.9	91.4
3	49.0	85.0	64.2	111.5	81.6	91.8	100.9	111.3	92.4	100.8	108.9
4	50.4	86.7	65.6	112.6	87.0	97.2	107.1	117.1	105.5	114.2	123.1
5	49.2	86.0	74.9	126.5	103.6	115.1	125.6	137.6	121.1	131.1	140.1
6	49.9	88.0	75.1	127.4	97.8	109.7	120.3	131.5	108.3	117.8	127.3
7	50.1	85.9	84.9	139.4	124.5	137.6	148.7	161.8	150.0	160.2	169.8
8	50.4	87.8	85.8	139.3	118.7	131.4	142.7	154.3	137.0	146.2	155.6
Control	138.1	184.7	184.7	228.6	228.6	239.2	247.4	256.3	256.3	255.9	261.0

Total stem volume per acre[6] (cubic feet[7])

Treatment numbers	Calibration		1st treatment period		2d treatment period		3d treatment period	
	1963	1966	1966[2]	1970	1970[3]	1973	1973[4]	1975
1	744	1,579	1,027	2,314	1,423	2,303	1,745	2,192
2	729	1,614	1,043	2,353	1,568	2,551	2,106	2,677
3	746	1,578	1,197	2,592	1,901	3,058	2,543	3,174
4	749	1,623	1,237	2,662	2,066	3,218	2,903	3,617
5	720	1,565	1,371	2,961	2,432	3,736	3,291	4,091
6	743	1,599	1,370	2,952	2,274	3,555	2,933	3,685
7	750	1,574	1,555	3,268	2,920	4,409	4,092	4,959
8	768	1,634	1,598	3,291	2,807	4,261	3,789	4,540
Control	1,982	3,362	3,362	5,411	5,411	6,955	6,955	7,508

[1] Rounded to nearest whole tree.

[2] 1966 data minus thinned trees.

[3] 1970 data minus thinned trees.

[4] 1973 data minus thinned trees.

[5] Diameter of tree of mean basal area.

[6] Derived from equations developed by David Bruce and Donald J. DeMars (1974. Volume equations for second-growth Douglas-fir. USDA For. Serv. Res. Note PNW-239, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.).

[7] Inside bark.

Table 2A--Stand data for all live trees in metric units, at beginning and end of periods, by treatment

Treatment numbers	Calibration		1st treatment period		2d treatment period				3d treatment period		
	Number of trees per hectare 1/										
	1963	1966	1966 2/	1970	1970 3/	1971	1972	1973	1973 4/	1974	1975
1	873	869	531	531	292	292	292	292	206	206	206
2	848	844	511	511	309	309	309	305	239	239	239
3	848	844	622	622	432	432	432	432	346	346	346
4	824	815	601	601	445	445	445	445	395	395	395
5	902	898	770	770	618	614	614	614	527	527	523
6	836	836	700	700	519	519	519	519	416	416	416
7	811	811	799	799	708	708	708	708	647	642	642
8	832	828	807	807	680	680	680	680	597	593	593
Control	4,267	4,053	4,053	3,142	3,142	2,973	2,829	2,685	2,685	2,392	2,318
	Quadratic mean diameter at breast height 5/ (centimeters)										
	1963	1966	1966 2/	1970	1970 3/	1971	1972	1973	1973 4/	1974	1975
1	12.9	17.0	17.4	23.4	24.6	26.2	27.7	29.2	30.2	31.7	33.1
2	13.1	17.4	17.9	24.0	25.0	26.7	28.2	29.8	30.6	32.0	33.5
3	13.0	17.1	14.7	22.9	23.5	24.9	26.2	27.4	27.9	29.2	30.3
4	13.4	17.6	17.9	23.4	23.9	25.4	26.7	27.7	27.9	28.9	30.2
5	12.6	16.7	16.9	21.9	22.1	23.4	24.4	25.6	25.9	26.9	28.0
6	13.2	17.5	17.7	23.1	23.5	24.9	26.2	27.2	27.6	28.7	29.9
7	13.4	17.6	17.6	22.6	22.7	23.9	24.9	25.8	26.0	26.9	27.8
8	13.3	17.6	17.6	22.5	22.6	23.9	24.9	25.8	25.9	26.9	27.7
Control	9.7	11.5	11.5	14.6	14.6	15.2	16.0	16.7	16.7	17.8	18.1
	Basal area per hectare (square meters)										
	1963	1966	1966 2/	1970	1970 3/	1971	1972	1973	1973 4/	1974	1975
1	11.3	19.6	12.7	22.8	13.9	15.8	17.5	19.5	14.8	16.2	17.7
2	11.5	20.0	12.8	23.1	15.2	17.3	19.3	21.3	17.6	19.3	21.0
3	11.3	19.5	14.7	25.6	18.7	21.1	23.2	25.5	21.2	23.1	25.0
4	11.6	19.9	15.1	25.9	20.0	22.3	24.6	26.9	24.2	26.2	28.3
5	11.3	19.7	17.2	29.0	23.8	26.4	28.8	31.6	27.8	30.1	32.2
6	11.4	20.2	17.2	29.2	22.5	25.2	27.6	30.2	24.9	27.0	29.2
7	11.5	19.7	19.5	32.0	28.6	31.6	34.1	37.1	34.4	36.8	39.0
8	11.6	20.2	19.7	32.0	27.2	30.2	32.7	35.4	31.4	33.6	35.7
Control	31.7	42.4	42.4	52.5	52.5	54.9	56.8	58.8	58.8	58.7	59.9

Total stem volume per hectare 6/ (cubic meters 7/)

Treatment numbers	Calibration		1st treatment period		2d treatment period		3d treatment period	
	1963	1966	1966 2/	1970	1970 3/	1973	1973 4/	1975
1	52	111	72	162	100	161	122	153
2	51	113	73	165	110	178	147	187
3	52	110	84	181	133	214	178	222
4	52	114	87	186	145	225	203	253
5	50	110	96	207	170	261	230	286
6	52	112	96	207	159	249	205	258
7	52	110	109	229	204	308	286	347
8	54	114	112	230	196	298	265	318
Control	139	235	235	379	379	487	487	525

1/ Rounded to nearest whole tree.

2/ 1966 data minus thinned trees.

3/ 1970 data minus thinned trees.

4/ 1973 data minus thinned trees.

5/ Diameter of tree of mean basal area.

6/ Derived from equations developed by David Bruce and Donald J. DeMars (1974. Volume equations for second-growth Douglas-fir. USDA For. Serv. Res. Note PNW-239, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.).

7/ Inside bark.

Table 3--Stand data for crop trees at beginning and end of treatment periods, by treatment

Treatment number	Number of trees per acre[1]				Quadratic mean diameter at breast height[2] (inches)							
	1963-70	1973	1974	1975	1963	1966	1970	1971	1972	1973[2]	1974	1975
1	80	80	80	80	5.7	7.5	10.1	10.8	11.3	12.0	12.6	13.1
2	80	78	78	78	5.9	7.8	10.4	11.1	11.8	12.4	13.0	12.6
3	80	80	80	80	5.8	7.6	10.0	10.6	11.1	11.6	12.2	12.6
4	80	80	80	80	5.9	7.8	10.2	10.8	11.3	11.9	12.3	12.8
5	80	80	80	80	5.8	7.7	10.0	10.6	11.0	11.6	12.1	12.5
6	80	80	80	80	5.9	7.8	10.1	10.7	11.1	11.7	12.2	12.7
7	80	80	80	80	6.1	7.9	10.1	10.6	11.0	11.5	11.9	12.2
8	80	80	80	80	5.8	7.7	9.8	10.4	10.8	11.2	11.6	12.0
Control	80	80	80	80	5.6	6.7	8.0	8.3	8.5	8.8	9.0	9.2

Treatment number	Basal area per acre (square feet)								Total stem volume per acre[3] (cubic feet[4])				
	1963	1966	1970	1971	1972	1973	1974	1975	1963	1966	1970	1973	1975
1	14.4	24.7	44.4	50.7	56.1	62.6	68.7	74.9	226	470	1,056	1,698	2,133
2	15.0	26.3	47.3	54.1	60.5	65.2	71.6	69.0	226	504	1,139	1,808	2,301
3	14.6	25.3	43.6	49.0	53.8	59.3	64.6	69.6	225	475	1,025	1,641	2,043
4	15.3	26.3	45.4	50.6	56.0	61.3	66.3	71.7	236	512	1,098	1,707	2,133
5	14.6	25.7	43.5	48.6	53.2	58.4	63.5	68.2	227	493	1,045	1,613	2,016
6	15.0	26.2	44.5	49.7	54.5	59.5	64.6	70.1	233	491	1,054	1,633	2,046
7	16.1	27.0	44.2	48.9	52.8	57.4	61.4	65.1	246	509	1,058	1,594	1,921
8	14.5	25.8	42.1	46.8	50.8	54.7	58.4	62.3	227	491	1,020	1,538	1,847
Control	13.8	19.6	27.7	29.8	31.5	33.5	34.9	36.3	217	385	689	947	1,086

1/ Rounded to nearest whole tree.

2/ Diameter of tree of mean basal area.

3/ Derived from equations developed by David Bruce and Donald J. DeMars (1974. Volume equations for second-growth Douglas-fir. USDA For. Serv. Res. Note PNW-239, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.).

4/ Inside bark.

Table 4--Gross periodic annual growth, total growth, and cumulative volume yield, in English units, for all trees, by treatment period

Quadratic mean diameter increment at breast height

Treatment numbers	Calibration period 1963-66		1st treatment period 1966-70		2d treatment period 1971	1972	1973	1970-73		3d treatment period 1974	1975	1973-75		Total, 1963-75	
	Inch	Percent	Inch	Percent	- - - Inch	- - -		Inch	Percent	- - Inch	- -	Inch	Percent	Inch	Percent
1	0.53	10.5	0.59	8.6	0.66	0.53	0.62	0.60	6.2	0.57	0.55	0.56	4.7	6.9	135
2	.55	10.6	.60	8.5	.67	.53	.59	.62	6.3	.57	.56	.56	4.7	7.0	134
3	.54	10.5	.54	7.9	.56	.49	.51	.52	5.6	.49	.45	.47	4.3	6.2	122
4	.55	10.4	.54	7.7	.54	.54	.48	.50	5.3	.44	.44	.44	4.0	6.2	117
5	.54	10.9	.50	7.5	.49	.41	.45	.45	5.2	.41	.41	.40	3.9	5.8	116
6	.57	11.0	.53	7.6	.54	.46	.47	.49	5.3	.47	.44	.46	4.2	6.2	119
7	.55	10.4	.49	7.1	.46	.38	.42	.42	4.7	.38	.31	.33	3.2	5.6	106
8	.56	10.7	.48	6.9	.47	.44	.39	.42	4.7	.38	.33	.34	3.3	5.6	108
Control	.21	5.5	.16	3.5	.17	.14	.15	.15	2.6	.12	.11	.11	1.7	1.9	50

Basal area per acre

Treatment numbers	Calibration period 1963-66		1st treatment period 1966-70		2d treatment period 1971	1972	1973	1970-73		3d treatment period 1974	1975	1973-75		Total, 1963-75	
	Square feet	Percent	Square feet	Percent	- - Square feet	- -		Square feet	Percent	Square feet		Square feet	Percent	Square feet	Percent
1	12.1	24.5	11.1	20.1	8.5	7.3	8.9	8.2	13.6	6.3	6.4	6.3	9.8	117.9	239
2	12.4	24.8	11.2	20.0	9.3	8.3	9.2	9.1	13.7	7.4	7.5	7.5	9.8	124.1	248
3	12.0	24.6	11.8	18.4	10.1	9.2	10.4	9.9	12.1	8.5	8.1	8.3	8.9	129.6	264
4	12.2	24.2	11.7	17.9	10.8	10.0	10.0	10.1	11.6	8.7	8.9	8.8	8.3	131.3	261
5	12.3	25.1	12.9	17.2	11.5	10.5	12.0	11.5	11.1	10.1	9.0	9.8	8.1	142.2	289
6	12.7	25.5	13.1	17.4	11.8	10.6	11.2	11.2	11.5	9.4	9.5	9.5	8.8	143.0	287
7	11.9	23.9	13.6	16.0	13.1	11.2	13.1	12.5	10.0	10.2	9.7	10.0	6.7	147.6	295
8	12.6	24.9	13.4	15.6	12.8	11.3	11.6	11.9	10.0	9.2	9.4	9.4	6.9	145.3	288
Control	16.2	11.7	14.2	7.7	14.0	11.1	11.8	12.3	5.4	9.4	8.2	8.8	3.4	159.9	116

Total stem volume per acre[1]

Treatment numbers	Periodic annual growth: Calibration period 1963-66		1st treatment period 1966-70		2d treatment period 1970-73		3d treatment period 1973-75		Total, 1963-75		Cumulative yield[2] 1966	1970	1973	1975
	Cubic feet[3]	Percent	Cubic feet[3]	Percent	Cubic feet[3]	Percent	Cubic feet[3]	Percent	Cubic feet[3]	Percent	- - - Cubic feet[3]	- - -		
1	279	37.5	322	31.3	293	20.6	223	12.8	3,451	464	1,581	2,868	3,748	4,195
2	296	40.6	328	31.4	328	20.9	286	13.6	3,754	515	1,616	2,926	3,912	4,484
3	278	37.3	349	29.1	385	20.3	316	12.4	4,017	538	1,581	2,975	4,131	4,762
4	293	39.1	356	28.8	384	18.6	357	12.3	4,171	557	1,628	3,054	4,206	4,920
5	283	39.4	398	29.0	439	18.1	408	12.4	4,573	635	1,570	3,160	4,477	5,293
6	285	38.4	396	28.9	427	18.8	376	12.8	4,472	602	1,599	3,182	4,463	5,215
7	275	36.6	428	27.5	496	17.0	437	10.7	4,900	653	1,574	3,286	4,775	5,650
8	290	37.7	423	26.5	485	17.3	378	10.0	4,772	621	1,637	3,330	4,784	5,540
Control	469	23.6	573	17.0	583	10.8	440	6.3	6,328	319	3,388	5,680	7,430	8,310

[1] Derived from equations developed by David Bruce and Donald J. DeMars (1974. Volume equations for second-growth Douglas-fir. USDA For. Serv. Res. Note PNW-239, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.).

[2] See appendix for explanation of how cumulative yield was derived. The cumulative volume yield data do not include the volume removed during the calibration thinning (estimated to be 1,238 ft^3).

[3] Inside bark.

Table 4A--Gross periodic annual growth, total growth, and cumulative volume yield, in metric units, for all trees, by treatment period

Quadratic mean diameter increment at breast height

Treatment numbers	Calibration period 1963-66		1st treatment period 1966-70		2d treatment period 1971	1972	1973	1970-73		3d treatment period 1974	1975	1973-75		Total, 1963-75	
	Centimeter	Percent	Centimeter	Percent	- - Centimeter	- -		Centimeter	Percent	Centimeter		Centimeter	Percent	Centimeter	Percent
1	1.3	10.5	1.5	8.6	1.68	1.35	1.57	1.5	6.2	1.45	1.40	1.4	4.7	17.5	135
2	1.4	10.6	1.5	8.5	1.70	1.35	1.50	1.5	6.1	1.45	1.42	1.4	4.7	17.8	135
3	1.4	10.5	1.4	7.9	1.42	1.24	1.30	1.3	5.6	1.24	1.14	1.2	4.3	15.7	122
4	1.4	10.4	1.4	7.7	1.37	1.37	1.22	1.3	5.3	1.12	1.12	1.1	4.0	15.7	117
5	1.4	10.9	1.3	7.5	1.24	1.04	1.14	1.1	5.2	1.04	1.04	1.0	3.9	14.7	116
6	1.4	11.0	1.3	7.6	1.37	1.17	1.19	1.2	5.3	1.19	1.12	1.2	4.2	15.7	119
7	1.4	10.4	1.2	7.1	1.17	0.97	1.07	1.1	4.7	0.97	0.79	0.8	3.2	14.2	106
8	1.4	10.7	1.2	6.9	1.19	1.12	0.99	1.1	4.7	0.97	0.84	0.9	3.3	14.2	108
Control	0.5	5.5	0.4	3.5	0.43	0.36	0.38	0.4	2.6	0.30	0.28	0.3	1.7	4.8	50

Basal area per hectare

Treatment numbers	Calibration period 1963-66		1st treatment period 1966-70		2d treatment period 1971	1972	1973	1970-73		3d treatment period 1974	1975	1973-75		Total, 1963-75	
	Square meters	Percent	Square meters	Percent	- Square meters	-		Square meters	Percent	- Square meters	-	Square meters	Percent	Square meters	Percent
1	2.8	24.5	2.5	20.1	1.9	1.7	2.0	1.9	13.6	1.4	1.5	1.5	9.8	27.1	239
2	2.9	24.8	2.6	20.0	2.1	1.9	2.1	2.0	13.4	1.7	1.7	1.7	9.8	28.5	248
3	2.8	24.6	2.7	18.4	2.3	2.1	2.4	2.3	12.1	1.9	1.9	1.9	8.9	29.8	264
4	2.8	24.2	2.7	17.9	2.5	2.3	2.3	2.3	11.6	2.0	2.0	2.0	8.3	30.1	261
5	2.8	25.1	3.0	17.2	2.6	2.4	2.7	2.6	11.1	2.3	2.1	2.3	8.1	32.6	289
6	2.9	25.5	3.0	17.4	2.7	2.4	2.6	2.6	11.5	2.2	2.2	2.2	8.8	32.8	287
7	2.7	23.9	3.1	16.0	3.0	2.6	3.0	2.8	10.0	2.3	2.2	2.3	6.7	33.9	295
8	2.9	24.9	3.1	15.6	2.9	2.6	2.7	2.7	10.0	2.1	2.2	2.2	6.9	33.4	288
Control	3.7	11.7	3.3	7.7	3.2	2.5	2.7	2.8	5.4	2.2	1.9	2.0	3.4	36.7	116

Total stem volume per hectare[1]

Treatment numbers	Periodic annual growth: Calibration period 1963-66		1st treatment period 1966-70		2d treatment period 1970-73		3d treatment period 1973-75		Total, 1963-75		Cumulative yield[2] 1966	1970	1973	1975
	Cubic meters[3]	Percent	Cubic meters[3]	Percent	Cubic meters[3]	Percent	Cubic meters[3]	Percent	Cubic meters[3]	Percent	- - - Cubic meters[3]	- - -		
1	19.5	37.5	22.5	31.3	20.5	20.6	15.6	12.8	241.5	464	110.6	200.7	262.3	293.5
2	20.7	40.6	22.9	31.4	22.7	20.7	20.0	13.6	262.7	515	113.1	204.8	273.0	313.7
3	19.5	37.3	24.4	29.1	27.0	20.3	22.1	12.4	281.1	538	110.6	208.2	289.1	333.2
4	20.5	39.1	24.9	28.8	26.9	18.6	25.0	12.3	291.8	557	113.9	213.7	294.3	344.3
5	19.8	39.4	27.8	29.0	30.7	18.1	28.6	12.4	320.0	635	109.8	221.1	313.3	370.4
6	20.0	38.4	27.7	28.9	29.9	18.8	26.3	12.8	312.9	602	111.9	222.6	312.3	364.9
7	19.2	36.6	30.0	27.5	34.6	16.9	30.6	10.7	342.9	653	110.1	230.0	333.7	395.3
8	20.3	37.7	29.3	26.5	33.9	17.3	26.4	10.0	333.9	621	114.6	233.0	334.8	387.6
Control	32.8	23.6	40.1	17.0	40.8	10.8	30.8	6.3	442.8	319	237.1	397.4	519.9	581.5

[1] Derived from equations developed by David Bruce and Donald J. DeMars (1974. Volume equations for second-growth Douglas-fir. USDA For. Serv. Res. Note PNW-239, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.).

[2] See appendix for how cumulative yield was derived. The cumulative volume yield data do not include the volume removed during the calibration thinning (estimated to be 125.3 m^3).

[3] Inside bark.

Table 5--Gross periodic annual growth and cumulative volume yield for crop trees, by treatment and treatment period

Treatment numbers	Quadratic mean diameter increment at breast height (inch)								
	1963-66	1966-70	1971	1972	1973	1970-73	1974	1975	1973-75
1	0.59	0.64	0.69	0.56	0.64	0.63	0.58	0.55	0.56
2	.63	.66	.72	.60	.65	.67	.60	.57	.58
3	.61	.60	.59	.51	.55	.55	.52	.46	.49
4	.61	.61	.59	.56	.52	.55	.48	.49	.48
5	.63	.58	.58	.49	.52	.53	.50	.43	.47
6	.63	.59	.57	.50	.50	.53	.50	.51	.50
7	.60	.55	.51	.42	.46	.47	.39	.35	.37
8	.64	.54	.53	.43	.44	.47	.38	.37	.37
Control	.36	.31	.30	.23	.25	.26	.18	.18	.18
	Basal area per acre (square feet)								
	1963-66	1966-70	1971	1972	1973	1970-73	1974	1975	1973-75
1	3.4	4.9	6.3	5.4	6.5	6.1	6.2	6.2	6.2
2	3.8	5.2	6.8	5.5	6.8	6.7	6.4	6.4	6.4
3	3.5	4.6	5.3	4.8	5.5	5.2	5.3	5.1	5.2
4	3.7	4.8	5.0	5.4	5.3	5.3	5.0	5.3	5.2
5	3.7	4.4	5.5	4.6	5.2	5.0	5.1	4.7	4.9
6	3.8	4.6	5.2	4.8	5.0	5.0	5.2	5.5	5.3
7	3.7	4.3	4.6	4.0	4.6	4.4	4.0	3.7	3.8
8	3.7	4.1	4.7	4.0	4.3	4.3	3.7	3.9	3.8
Control	2.0	2.1	2.1	1.7	2.0	1.9	1.4	1.4	1.4

Treatment numbers	Total stem volume per acre[1] (cubic feet[2])							
	Periodic annual growth				Cumulative yield			
	1963-66	1966-70	1970-73	1973-75	1963-66	1966-70	1970-73	1973-75
1	82	146	214	217	470	1,056	1,698	2,133
2	93	159	241	246	504	1,139	1,862	2,301
3	83	137	205	201	475	1,025	1,641	2,043
4	92	146	203	213	512	1,098	1,707	2,133
5	89	138	190	202	493	1,045	1,613	2,017
6	86	141	193	206	491	1,054	1,633	2,046
7	88	137	179	164	509	1,058	1,594	1,921
8	88	132	177	154	491	1,020	1,550	1,847
Control	56	76	86	69	385	689	947	1,086

[1] Derived from equations developed by David Bruce and Donald J. DeMars (1974. Volume equations for second-growth Douglas-fir. USDA For. Serv. Res. Note PNW-239, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.).

[2] Inside bark.

Table 6--Periodic annual mortality of all trees, by treatment and treatment period

Treatment numbers	Number of trees per acre[1]								
	1963-66	1966-70	1971	1972	1973	1970-73	1974	1975	1973-75
1	1	0	0	0	0	0	0	0	0
2	1	0	0	0	2	1	0	0	0
3	1	0	0	0	0	0	0	0	0
4	1	0	0	0	0	0	0	0	0
5	1	0	2	0	0	1	0	1	1
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	2	0	1
8	1	0	0	0	0	0	2	0	1
Control	29	92	69	58	58	62	118	30	74
	Quadratic mean diameter at breast height[2] (inches)								
	1963-66	1966-70	1971	1972	1973	1970-73	1974	1975	1973-75
1	3.5	0	0	0	0	0	0	0	0
2	4.2	0	0	0	4.3	4.3	0	0	0
3	4.1	0	0	0	0	0	0	0	0
4	4.1	0	0	0	0	0	0	0	0
5	5.4	0	7.6	0	0	7.6	0	8.0	8.0
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	5.2	0	5.2
8	5.0	0	0	0	0	0	5.0	0	5.0
Control	2.1	2.5	3.1	3.0	3.1	3.0	3.9	4.4	4.0
	Basal area per acre (square feet)								
	1963-66	1966-70	1971	1972	1973	1970-73	1974	1975	1973-75
1	0.04	0	0	0	0	0	0	0	0
2	.05	0	0	0	.17	.06	0	0	0
3	.05	0	0	0	0	0	0	0	0
4	.10	0	0	0	0	0	0	0	0
5	.09	0	.52	0	0	.17	0	.58	.29
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	.25	0	.12
8	.08	0	0	0	0	0	.23	0	.11
Control	.68	3.18	3.46	2.86	3.00	3.10	9.81	3.11	6.46

Treatment numbers	Total stem volume[3] per acre (cubic feet[4])			
	1963-66	1966-70	1970-73	1973-75
1	0.6	0	0	0
2	.8	0	1	0
3	.9	0	0	0
4	1.6	0	0	0
5	1.4	0	4.6	8.3
6	0	0	0	0
7	0	0	0	3.2
8	1.2	0	0	2.6
Control	8.8	60.6	68.8	163.6

1/ Rounded to nearest whole tree.

2/ Diameter of tree of mean basal area.

3/ Derived from equations developed by David Bruce and Donald J. DeMars (1974. Volume equations for second-growth Douglas-fir. USDA For. Serv. Res. Note PNW-239, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.).

4/ Inside bark.

Table 7--Basic data by treatment and plot for all live trees 1971-75 (second and third treatment periods)

Treatment and plot numbers	Number of trees per acre[1]					Quadratic mean diameter at breast height[3] (inches)					Basal area per acre (square feet)					Total stem volume per acre[4] (cubic feet[5])	
	1971	1972	1973[2]	1974	1975	1971	1972	1973[2]	1974	1975	1971	1972	1973[2]	1974	1975	1973[2]	1975
1:																	
3	115	115	115	85	85	10.5	11.1	11.7	12.4	12.9	69.4	76.7	86.0	71.2	77.7	2,246	2,138
8	120	120	120	80	80	10.2	10.7	11.3	12.7	13.2	68.2	75.4	84.2	70.6	76.7	2,361	2,224
20	120	120	120	85	85	10.3	10.8	11.4	12.3	12.9	69.1	76.5	85.1	70.2	76.6	2,301	2,213
2:																	
4	135	135	135	105	105	10.2	10.7	11.3	12.2	12.7	76.0	85.0	93.5	85.2	93.0	2,523	2,626
15	100	100	100	75	75	11.7	12.4	13.1	14.4	15.0	75.3	84.2	93.1	84.5	92.3	2,639	2,810
17	140	140	135	110	110	9.9	10.5	11.3	11.7	12.2	75.3	83.6	93.3	81.9	89.0	2,489	2,596
3:																	
7	200	200	200	160	160	9.2	9.6	10.1	10.8	11.2	91.8	101.3	117.5	101.0	109.2	3,096	3,158
11	160	160	160	125	125	10.3	10.8	11.3	12.2	12.7	92.1	101.0	111.5	101.4	109.7	3,080	3,187
21	165	165	165	135	135	10.1	10.6	11.0	11.7	12.1	91.4	100.6	109.9	100.1	107.7	2,998	3,177
4:																	
5	205	205	205	180	180	9.3	9.8	10.3	10.8	11.2	96.7	107.1	117.8	115.0	124.1	3,017	3,333
18	185	185	185	165	165	9.9	10.3	10.8	11.3	11.7	98.1	107.8	118.0	114.3	122.9	3,241	3,661
23	150	150	150	135	135	10.9	11.4	11.9	12.4	12.9	96.6	106.4	115.2	113.4	122.3	3,398	3,857
5:																	
9	250	250	250	215	215	9.2	9.6	10.0	10.6	10.9	114.6	125.2	136.9	130.7	139.2	3,883	4,262
24	230	230	230	200	200	9.6	10.0	10.4	11.0	11.4	114.9	125.0	137.1	131.3	140.7	3,677	3,975
27	265	265	265	224	220	8.9	9.4	9.8	10.3	10.8	115.7	126.6	138.8	131.3	140.6	3,647	4,035
6:																	
1	210	210	210	170	170	9.8	10.4	10.7	11.2	11.7	109.7	120.5	131.1	116.9	126.4	3,543	3,681
2	225	225	225	180	180	9.4	9.9	10.4	11.0	11.4	109.7	120.4	132.0	117.7	127.6	3,449	3,556
25	195	195	195	155	155	10.1	10.6	11.1	11.8	12.3	109.6	119.9	131.6	118.7	127.8	3,672	3,818
7:																	
12	300	300	300	275	275	9.1	9.5	9.9	10.3	10.6	137.0	148.0	161.0	160.1	169.4	4,402	4,996
14	270	270	270	245	245	9.4	9.8	10.2	10.9	11.3	138.5	149.7	163.5	160.0	169.4	4,477	4,930
19	290	290	290	260	260	9.3	9.7	10.1	10.6	11.0	137.2	148.6	161.0	160.4	170.7	4,348	4,952
8:																	
6	300	300	300	260	260	9.0	9.4	9.7	10.1	10.4	131.8	143.2	154.4	145.9	154.9	4,184	4,462
13	270	270	270	240	235	9.4	9.8	10.2	10.6	11.0	130.6	140.9	153.0	144.9	153.9	4,103	4,346
16	255	255	255	225	225	9.7	10.2	10.6	11.0	11.3	131.9	144.0	155.4	147.7	157.9	4,496	4,812
Control:																	
10	1,355	1,270	1,205	1,205	1,100	5.6	5.8	6.1	6.3	6.5	228.7	234.9	243.5	246.2	250.0	6,269	6,668
22	1,025	1,005	965	965	800	6.7	7.0	7.2	7.7	8.0	255.0	265.5	275.4	272.8	277.1	7,843	8,530
26	1,230	1,160	1,090	1,090	915	5.9	6.2	6.5	7.0	7.2	233.9	241.9	250.0	248.8	255.9	6,753	7,325

1/ Rounded to nearest whole tree.

2/ Data before thinning.

3/ Diameter of tree of mean basal area.

4/ Derived from equations developed by David Bruce and Donald J. DeMars (1974. Volume equations for second-growth Douglas-fir. USDA For. Serv. Res. Note PNW-239, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.).

5/ Inside bark.

Table 8--Basic data by treatment and plot for crop trees (second and third treatment periods), 1971-75

Treatment and plot numbers	Number of trees per acre[1/]			Quadratic mean diameter at breast height[2/] (inches)					Basal area per acre (square feet)					Total stem volume per acre[3/] (cubic feet[4/])		Height (feet)	
	1971	1973	1975	1971	1972	1973	1974	1975	1971	1972	1973	1974	1975	1973	1975	1973	1975
1:																	
3	80	80	80	10.7	11.3	11.9	12.5	13.1	50.4	55.8	62.2	64.5	74.8	1,632	2,060	67.4	71.9
8	80	80	80	10.9	11.5	12.2	12.7	13.2	52.2	57.9	64.5	70.6	76.7	1,809	2,224	69.7	74.7
20	80	80	80	10.6	11.2	11.8	12.4	12.9	49.4	54.6	61.0	67.0	73.2	1,654	2,113	68.2	73.7
2:																	
4	80	80	80	10.6	11.2	11.8	12.4	12.9	49.2	55.1	60.6	67.1	72.9	1,641	2,064	68.6	72.6
15	80	75	75	12.3	13.0	13.7	14.4	15.0	66.3	74.1	81.7	84.5	92.3	2,329	2,810	74.3	80.4
17	80	80	80	10.3	10.9	11.7	12.0	12.6	46.7	52.8	59.7	63.2	69.0	1,616	2,028	68.0	74.3
3:																	
7	80	80	80	10.1	10.7	11.2	11.8	12.2	44.8	49.6	55.2	60.5	65.4	1,537	1,916	70.7	75.4
11	80	80	80	11.2	11.7	12.2	12.8	13.2	54.4	59.4	65.1	71.1	76.7	1,816	2,241	71.3	75.4
21	80	80	80	10.5	11.0	11.5	11.9	12.4	47.7	52.4	57.5	62.2	66.8	1,570	1,972	67.9	73.7
4:																	
5	80	80	80	10.3	10.9	11.4	11.9	12.4	46.8	51.8	57.0	61.8	66.6	1,493	1,830	65.0	68.0
18	80	80	80	10.1	10.6	11.1	11.6	12.1	44.5	49.1	53.8	58.6	63.3	1,478	1,886	69.5	76.3
23	80	80	80	11.8	12.4	12.9	13.4	14.0	60.6	67.2	73.0	78.7	85.1	2,151	2,683	76.0	82.0
5:																	
9	80	80	80	10.3	10.8	11.3	11.8	12.1	46.4	50.8	55.8	60.5	64.4	1,613	1,992	72.2	77.7
24	80	80	80	11.1	11.6	12.1	12.7	13.1	53.4	58.4	64.1	69.9	75.0	1,773	2,182	69.4	74.5
27	80	80	80	10.3	10.8	11.2	11.8	12.2	46.1	50.5	55.2	60.2	65.1	1,454	1,875	65.9	72.3
6:																	
1	80	80	80	10.7	11.2	11.7	12.2	12.7	50.3	55.2	59.9	64.9	70.3	1,653	2,048	69.3	73.9
2	80	80	80	10.2	10.7	11.2	11.7	12.2	45.8	50.3	54.9	59.9	65.3	1,451	1,842	66.0	71.0
25	80	80	80	11.0	11.5	12.1	12.6	13.1	52.9	57.9	63.6	69.2	74.8	1,796	2,248	71.3	76.8
7:																	
12	80	80	80	10.2	10.6	11.1	11.4	11.8	45.6	49.3	53.6	57.0	60.3	1,482	1,796	69.0	74.5
14	80	80	80	11.1	11.6	12.1	12.6	12.9	54.0	58.7	64.0	68.7	72.8	1,791	2,150	70.7	75.3
19	80	80	80	10.4	10.8	11.2	11.6	11.9	47.0	50.6	54.6	58.5	62.1	1,508	1,817	68.8	73.2
8:																	
6	80	80	80	10.6	11.1	11.5	11.9	12.3	49.0	53.4	57.9	61.8	65.8	1,638	1,972	70.5	74.9
13	80	80	80	10.6	11.0	11.5	11.9	12.3	48.8	52.7	57.7	61.6	65.6	1,578	1,884	68.8	73.0
16	80	80	80	9.9	10.3	10.7	10.9	11.2	45.2	49.1	53.1	51.9	55.5	1,525	1,685	70.8	75.2
Control:																	
10	80	80	80	8.0	8.3	8.5	8.7	8.8	28.2	29.8	31.7	32.8	33.8	871	971	65.7	68.7
22	80	80	80	8.5	8.7	8.9	9.1	9.4	30.6	32.0	33.8	35.2	36.9	998	1,156	69.0	76.3
26	80	80	80	8.4	8.7	8.9	9.1	9.3	30.8	32.7	34.8	36.4	37.9	974	1,131	66.0	70.4

1/ Rounded to nearest whole tree.

2/ Diameter of tree of mean basal area.

3/ Derived from equations developed by David Bruce and Donald J. DeMars (1974. Volume equations for second-growth Douglas-fir. USDA For. Serv. Res. Note PNW-239, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.).

4/ Inside bark.

Table 9--Stand table after second treatment thinning, 1970

D.b.h. class	Treatment number								
	1	2	3	4	5	6	7	8	Control
Inches	In number of trees per acre[1/]								
2									53
3									223
4		2			2				267
5			3	5	15	5	8	18	220
6	5	3	15	10	28	13	32	23	172
7	7	7	22	22	30	17	33	38	125
8	20	20	35	30	47	47	47	50	103
9	30	30	32	32	57	48	67	52	58
10	28	22	28	33	42	30	58	50	30
11	8	23	18	32	17	20	25	22	12
12	17	12	17	10	7	18	10	17	3
13	3	7	3	5	7	2	7	5	3
14			2	2					
15									2
Total	118	125	175	180	250	210	287	275	1,272

[1/] Rounded to nearest whole tree.

Table 10--Trees removed at beginning of the second and third treatment periods, 1970 and 1973

Treatment number	Number of trees[1/]		Quadratic mean diameter at breast height[2/] (inches)		Basal area (square feet)				Volume[3/] (cubic feet[4/])			
					Total		Per tree		Total		Per tree	
	1970	1973	1970	1973	1970	1973	1970	1973	1970	1973	1970	1973
1	97	35	8.6	10.4	39.1	20.7	0.40	0.59	892	558	9.2	15.9
2	82	26	8.8	10.9	34.3	16.8	.42	.65	785	445	9.6	19.1
3	77	35	8.4	10.0	29.9	18.9	.39	.54	690	514	9.0	14.7
4	63	20	8.6	10.3	25.7	11.6	.41	.58	596	316	9.5	15.8
5	62	35	8.3	9.3	22.9	16.5	.37	.47	529	445	8.5	12.7
6	73	42	8.6	10.0	29.5	23.2	.40	.55	678	623	9.3	14.8
7	37	25	8.6	9.3	14.9	11.8	.40	.47	348	317	9.4	12.7
8	52	33	8.6	9.8	20.6	17.3	.40	.52	484	472	9.3	14.3

1/ Rounded to nearest whole tree.

2/ Diameter of tree of mean basal area.

3/ Derived from equations developed by David Bruce and Donald J. DeMars (1974. Volume equations for second-growth Douglas-fir. USDA For. Serv. Res. Note PNW-239, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.).

4/ Inside bark.

Table 11--Stand table at end of second treatment period, 1973

D.b.h. class	Treatment number								
	1	2	3	4	5	6	7	8	Control
Inches	Number of trees per acre[1]								
2									7
3									103
4					2				207
5					5	2	5	8	200
6			7	5	13	5	18	13	153
7	5	2	5	10	30	12	18	22	140
8	3	5	25	22	18	15	32	33	103
9	12	12	15	12	37	33	38	40	72
10	25	17	38	35	38	42	52	40	50
11	13	28	25	33	50	35	58	55	28
12	30	20	25	27	33	28	38	32	13
13	12	20	17	25	10	30	18	20	5
14	15	12	15	7	7	7	7	10	2
15	2	7	2	3	5	2	2	2	2
16	2	2	2	2					2
Total	118	123	175	180	248	210	287	275	1,087

[1] Rounded to nearest whole tree.

Table 12--Periodic annual net increment data for all trees by treatment and thinning period

Treatment numbers	Quadratic mean diameter at breast height[1] (inches)				
	1963-66	1966-70	1970-73	1973-75	1963-75[2]
1	0.53	0.57	0.60	0.55	7.9
2	.53	.60	.63	.60	8.0
3	.57	.55	.50	.45	6.8
4	.53	.55	.50	.45	6.6
5	.53	.50	.47	.40	6.0
6	.57	.52	.50	.45	6.6
7	.53	.50	.43	.30	5.6
8	.57	.47	.40	.35	5.7
Control	.23	.30	.30	.25	3.3
	Basal area per acre (square feet)				
	1963-66	1966-70	1970-73	1973-75	1963-75
1	12.1	11.1	8.2	6.3	121.6
2	12.4	11.1	9.0	7.4	126.8
3	12.0	11.8	9.9	8.2	132.9
4	12.1	11.7	10.0	8.8	133.4
5	12.3	12.9	11.3	9.5	145.0
6	12.7	13.0	11.2	9.5	146.5
7	11.8	13.6	12.4	9.9	152.4
8	12.5	13.4	11.9	9.3	150.3
Control	15.5	11.0	9.2	2.3	136.6
	Volume per acre[3] (cubic feet[4])				
	1963-66	1966-70	1970-73	1973-75	1963-75
1	278	322	293	223	3,225
2	295	327	328	285	3,463
3	277	349	385	315	3,698
4	291	356	384	357	3,423
5	282	398	435	400	4,140
6	285	396	427	376	4,096
7	275	428	496	433	4,559
8	289	423	485	375	4,387
Control	460	512	515	276	5,249

[1] Diameter of tree of mean basal area.

[2] Difference between average diameter at end of 1975 growing season and quadratic mean diameter at end of 1963 growing season.

[3] Derived from equations developed by David Bruce and Donald J. DeMars (1974. Volume equations for second-growth Douglas-fir. USDA For. Serv. Res. Note PNW-239, 5 p. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.).

[4] Inside bark.

Table 13--Stand table after third treatment thinning, 1973

D.b.h. class	Treatment number								
	1	2	3	4	5	6	7	8	Control
Inches	In number of trees per acre[1/]								
2									7
3									103
4					2				207
5					5	2	5	8	200
6			2	5	10	2	17	10	153
7		2	3	8	20	8	12	22	140
8		0	20	17	17	12	30	27	103
9	7	8	7	8	27	23	35	32	72
10	20	13	35	32	35	33	47	35	50
11	10	20	22	33	48	30	55	53	28
12	20	18	22	23	33	27	35	27	13
13	10	17	15	25	8	27	18	17	5
14	13	10	12	3	3	3	7	10	2
15	2	7	2	3	5	2	2	2	2
16	2	2	2	2					2
Total	83	97	140	160	213	168	262	242	1,087

[1/] Rounded to nearest whole tree.

Table 14--Stand table at end of third treatment period, 1975

D.b.h. class	Treatment number								
	1	2	3	4	5	6	7	8	Control
Inches	In number of trees per acre[1/]								
3									42
4					2				157
5						2	3	7	163
6				2	12	2	8	7	132
7		2	3	7	12	5	18	18	145
8			15	12	18	7	17	18	83
9		2	7	13	15	10	30	23	95
10	7	10	8	8	28	22	32	32	50
11	17	10	30	32	33	32	48	40	32
12	13	20	23	28	40	33	52	43	22
13	18	15	22	23	32	27	28	30	8
14	12	15	17	22	10	17	17	13	7
15	13	15	12	8	5	12	7	7	2
16		2	2	3	5	2		2	
17	3	7	2	2					2
Total	83	97	140	160	212	168	260	240	938

[1/] Rounded to nearest whole tree.

Study area	*Cooperator*
Skykomish	Forestry Research Center Weyerhaeuser Company Centralia, Washington
Hoskins	School of Forestry Oregon State University Corvallis, Oregon
Rocky Brook	U.S. Forest Service Region 6 and Pacific Northwest Forest and Range Experiment Station Portland, Oregon
Clemons	Forestry Research Center Weyerhaeuser Company Centralia, Washington
Francis	Washington State Department of Natural Resources Olympia, Washington
Iron Creek	U.S. Forest Service Region 6 and Pacific Northwest Forest and Range Experiment Station Portland, Oregon
Stampede Creek	U.S. Forest Service Region 6 and Pacific Northwest Forest and Range Experiment Station Portland, Oregon
Sayward Forest	Canadian Forestry Service Department of the Environment Victoria, British Columbia
Shawnigan Lake	Canadian Forestry Service Department of the Environment Victoria, British Columbia

Consultative services have been provided by the University of Washington, Seattle, and the Bureau of Land Management, U.S. Department of the Interior.

GPO 988-758

Berg, Alan B., and John F. Bell.
1979. Levels-of-Growing-Stock Cooperative Study in Douglas-fir: Report No. 5--The Hoskins Study, 1963-75. USDA For. Serv. Res. Pap. PNW-257, 29 p., illus. Pac. Northwest For. and Range Exp. Stn., Portland, Oreg.

Growth data are presented for the first 12 years of management of a young Douglas-fir stand in the Oregon Coast Ranges manipulated to include eight levels of growing stock. The second and third treatment periods are described, and summary data from the calibration and first treatment periods are given.

The study dramatically demonstrates the capability of young Douglas-fir stands to transfer the growth from many trees to few trees. It also indicates that at least some of the treatments have the potential to equal or surpass the gross cubic-foot volume of the controls during the next treatment periods.

KEYWORDS: Growing stock (-increment/yield, thinnings, Douglas-fir, *Pseudotsuga menziesii*.

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3. Achieving optimum sustained resource productivity consistent with maintaining a high quality forest environment.

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